Applicant: Paul C. Wacker et el.
Serial No.: 10/643,430
Filed: August 18, 2003
For: PDA CONFIGURATION OF THERMOSTATS
Docket: H0005400(1161.1127101)
REPLACEMENT DRAWING

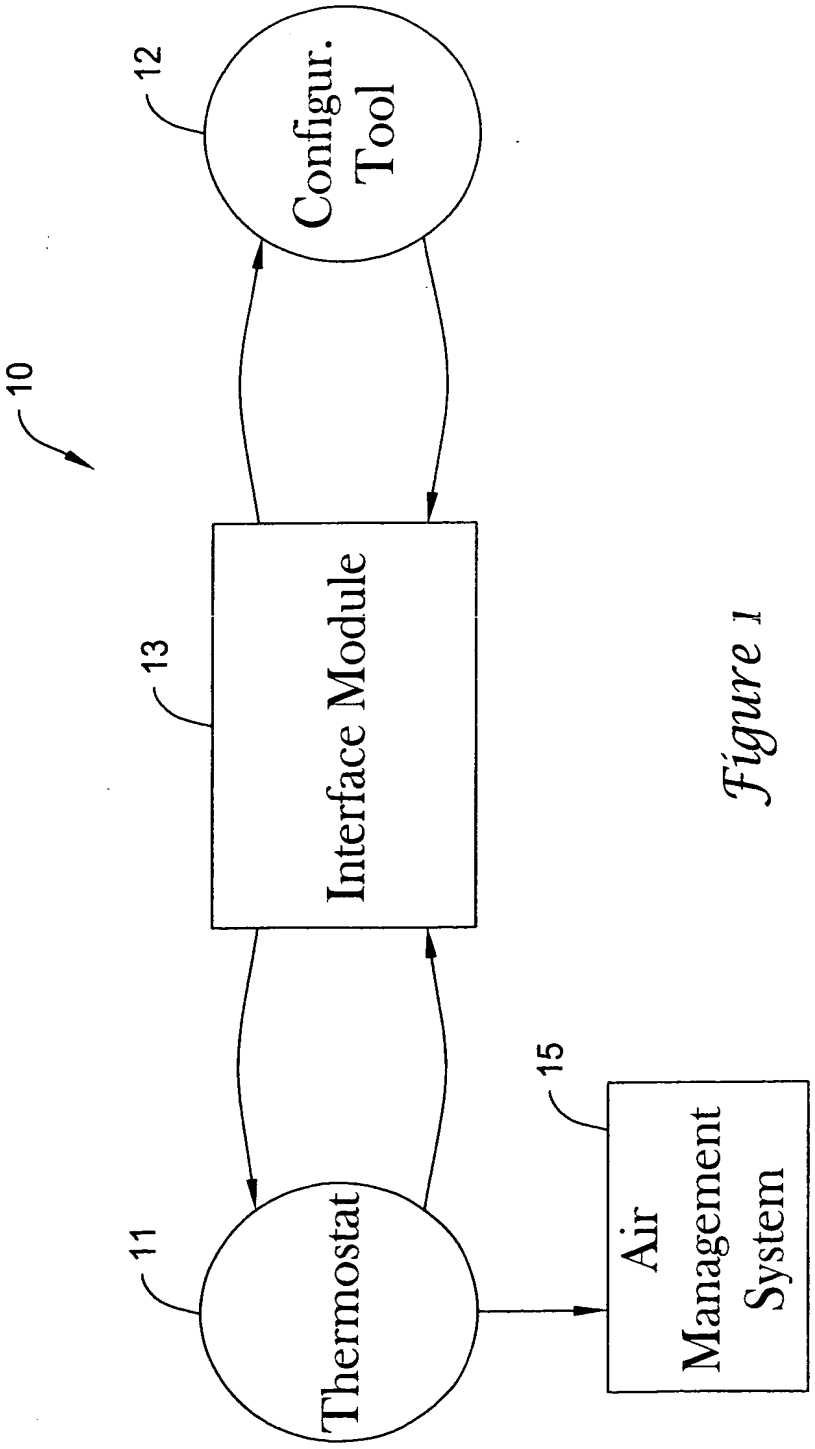
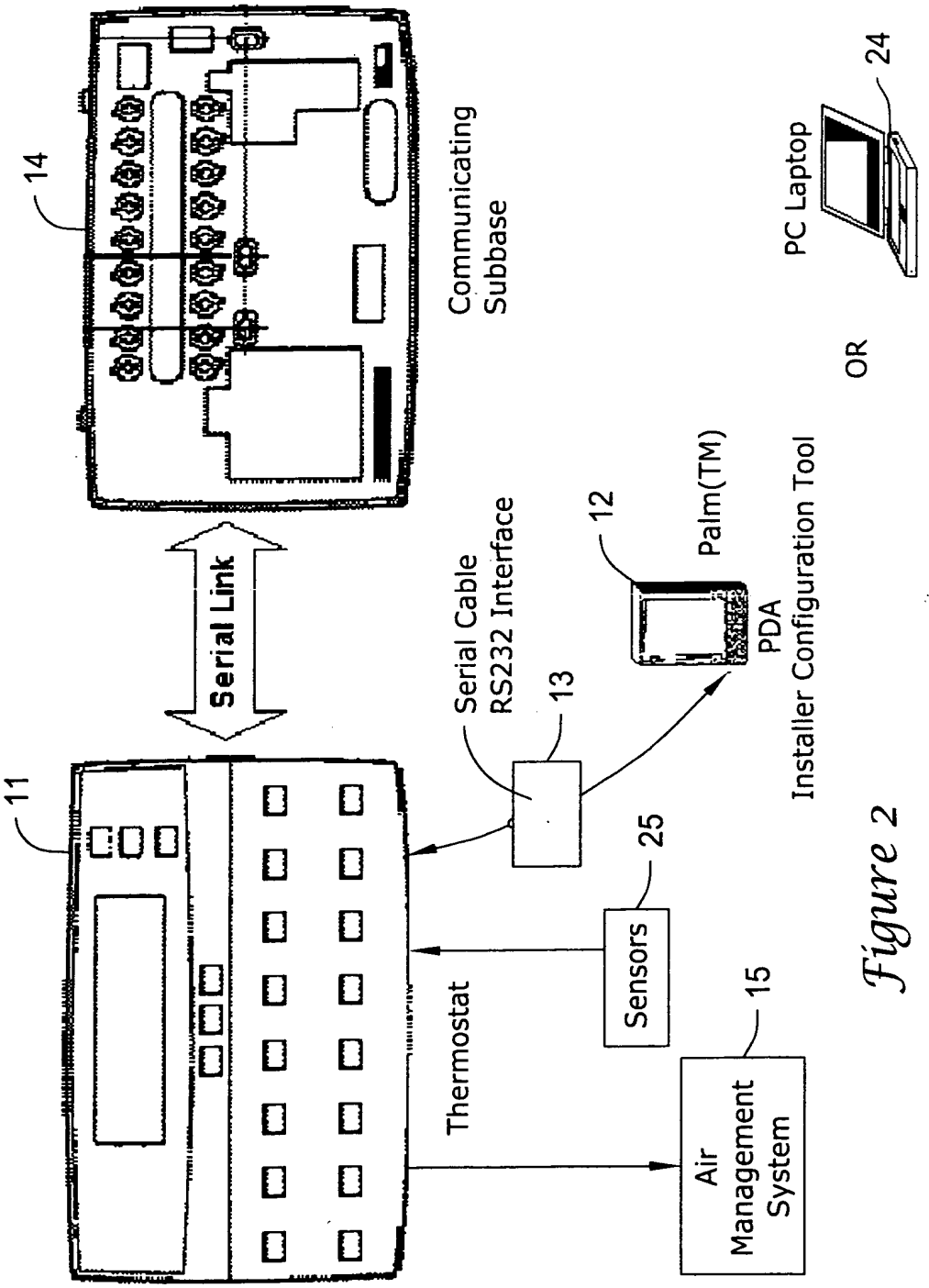


Figure 1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Communicating Subbase
PC Laptop
24
OR
Serial Link
Serial Cable RS232 Interface
12
Palm(TM) PDA
Installer Configuration Tool
13
11
25
Sensors
Thermostat
15
Air Management System

Figure 2

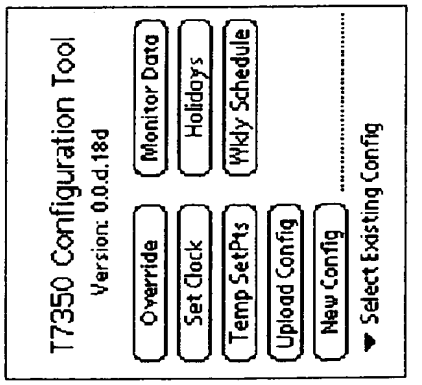


Figure 3A

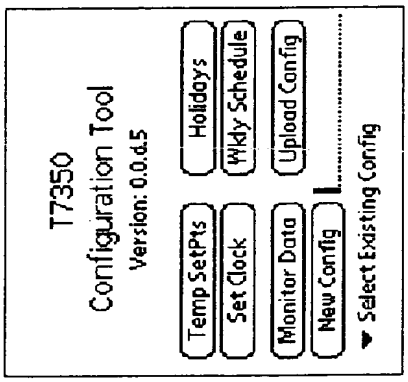
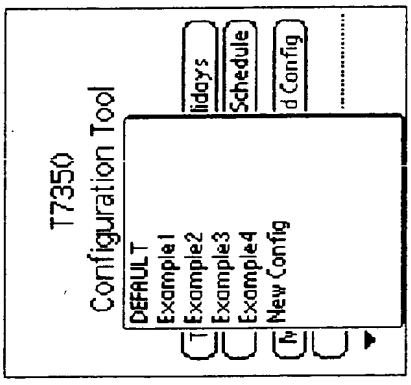


Figure 4A

Figure 3B



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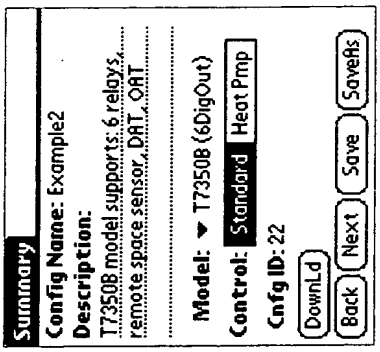

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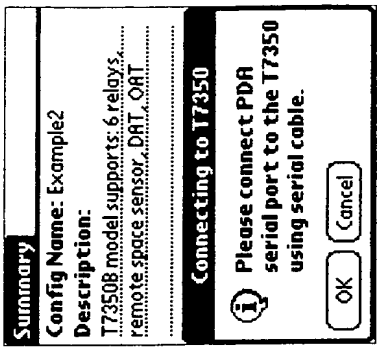

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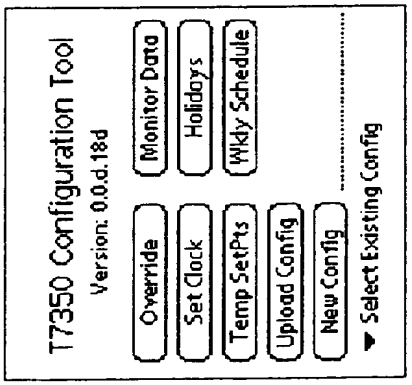

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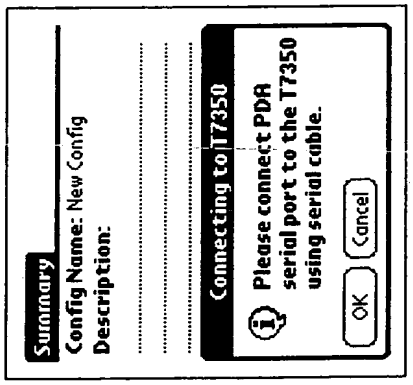

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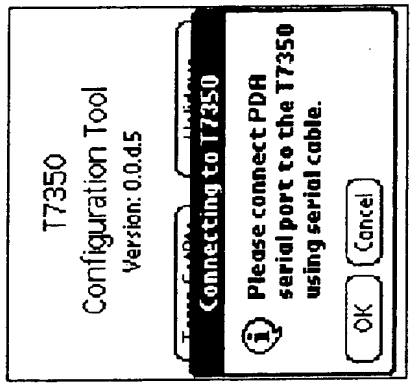

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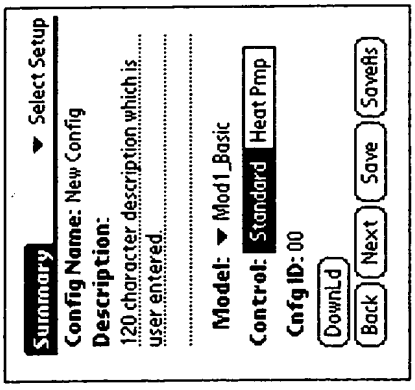

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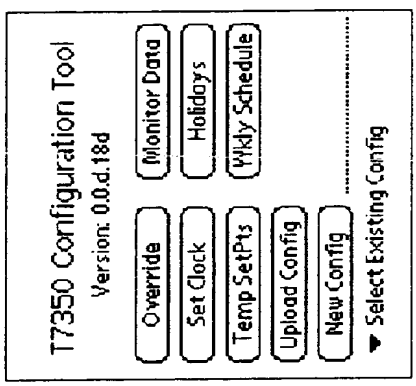
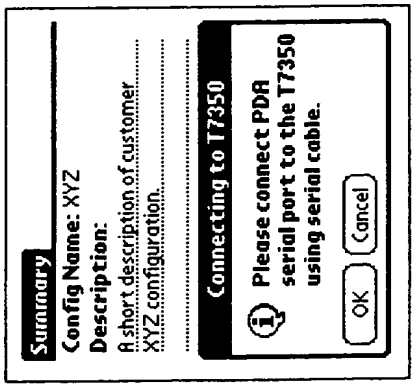


Figure 6B

Figure 6C



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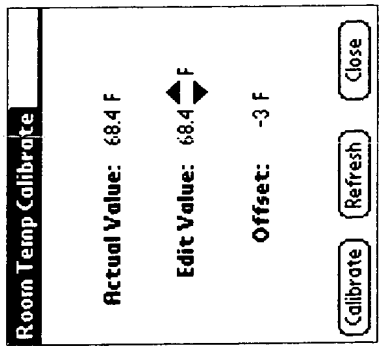
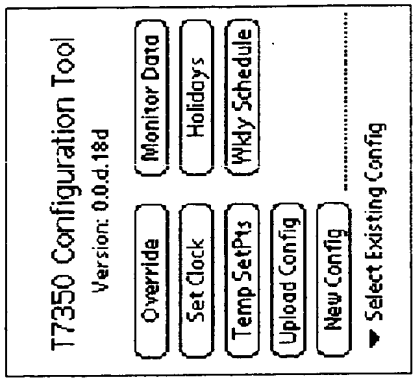


Figure 7B

Figure 7A



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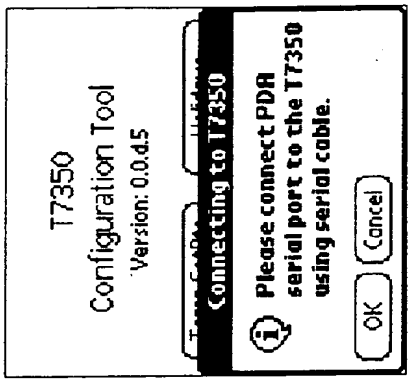

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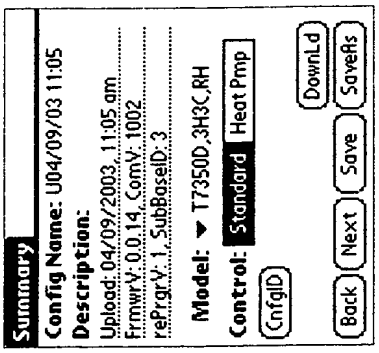

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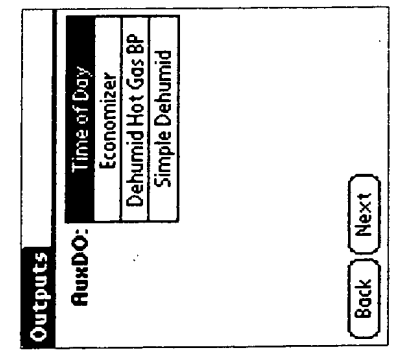
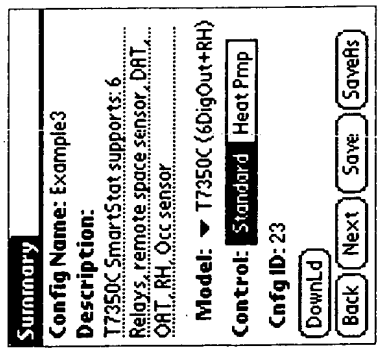


Figure 9C



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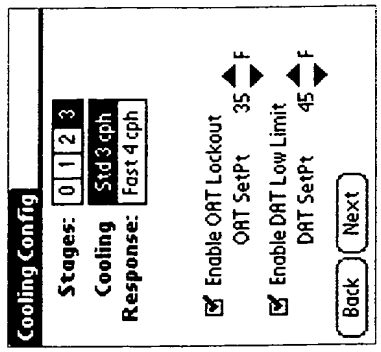

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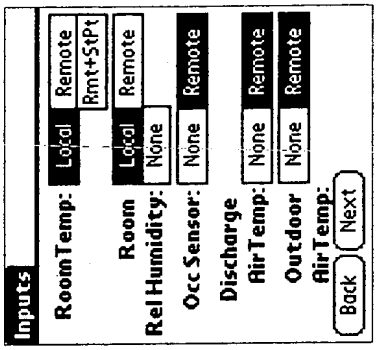

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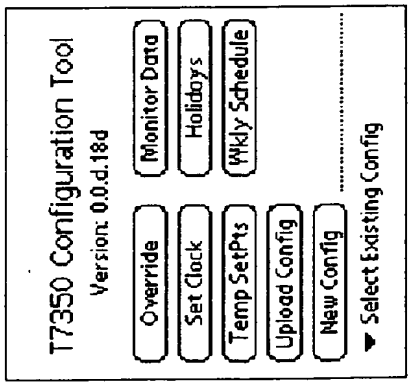

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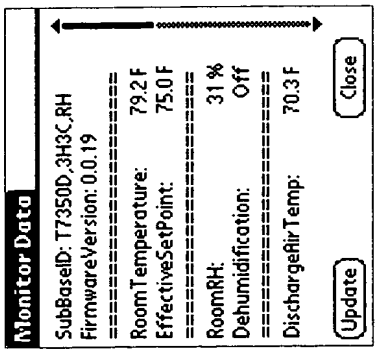

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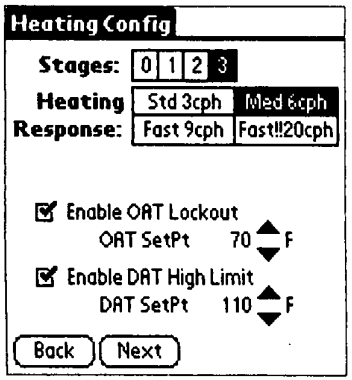

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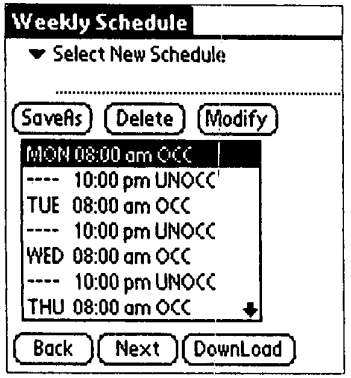

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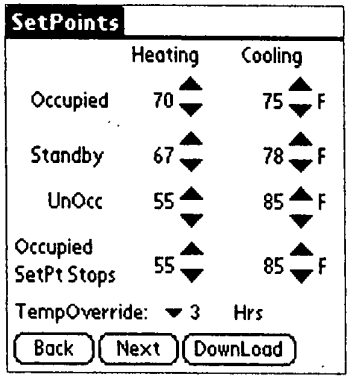
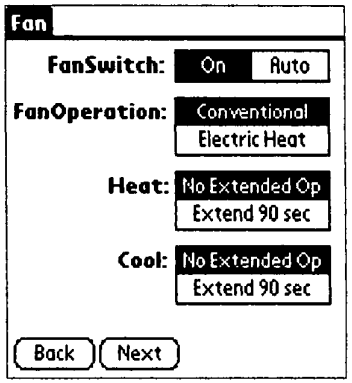


Figure 9I



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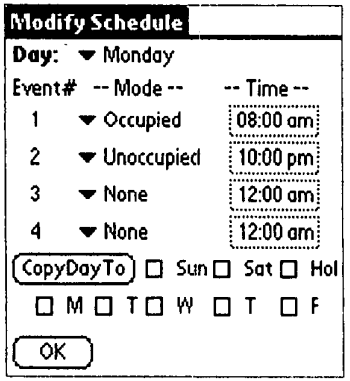

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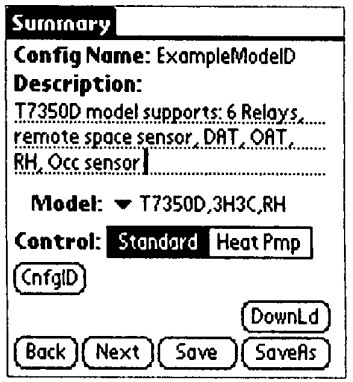


Figure 9J

Figure 10A

Figure 10B

Figure 10C

Figure 10D

Figure 10E

Figure 10F

Figure 10G

Figure 10I

Figure 10K

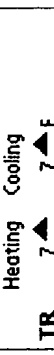


Figure 10H

Figure 10J

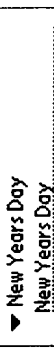


Figure 10L

Figure 11A

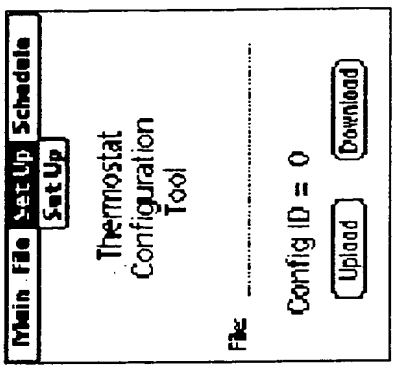
Figure 11B

Figure 12A

Figure 12B

Figure 12C

Figure 12D



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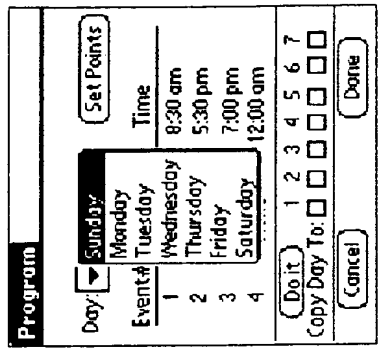

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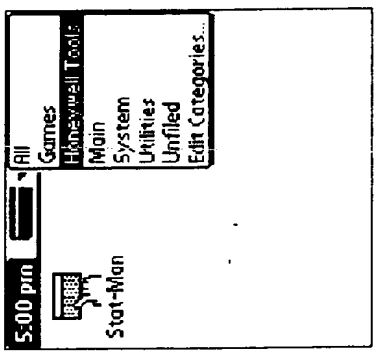

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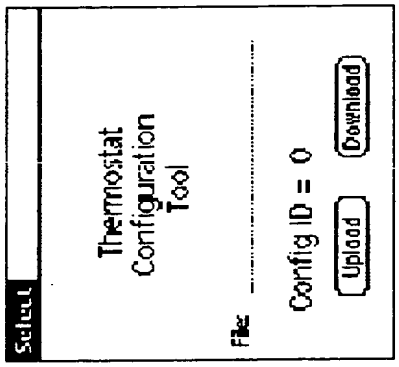

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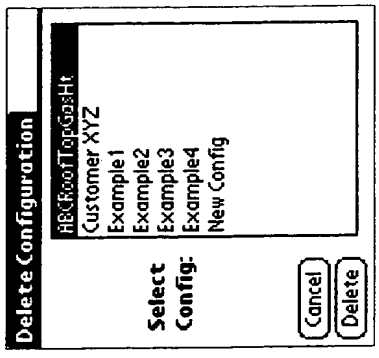

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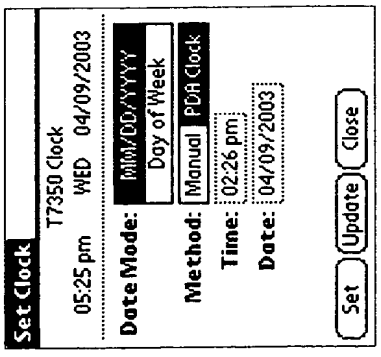

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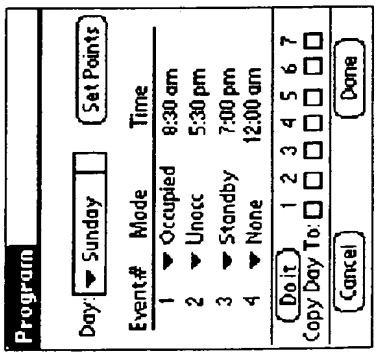

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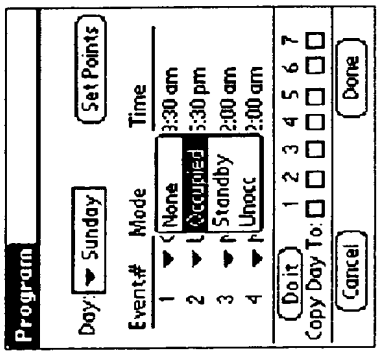

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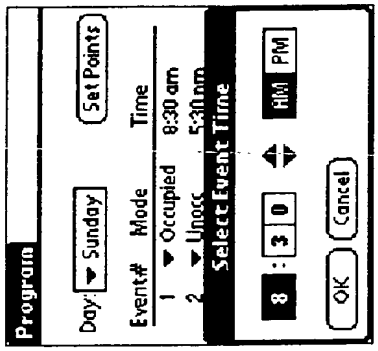

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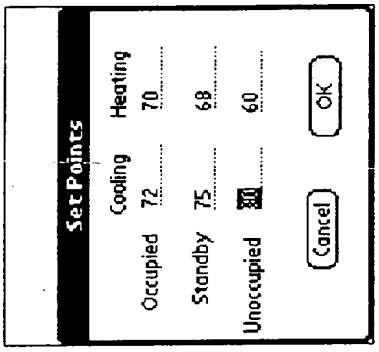

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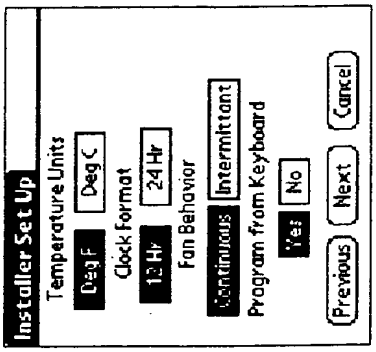

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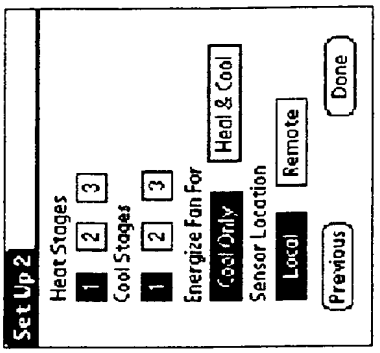

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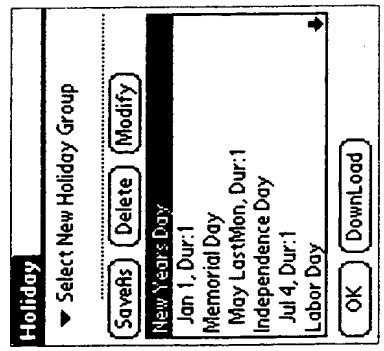

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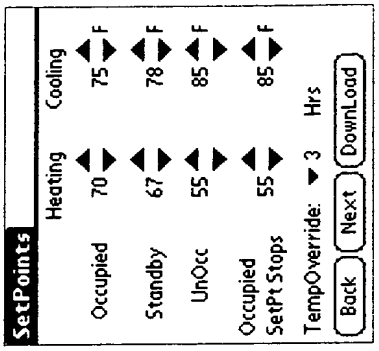

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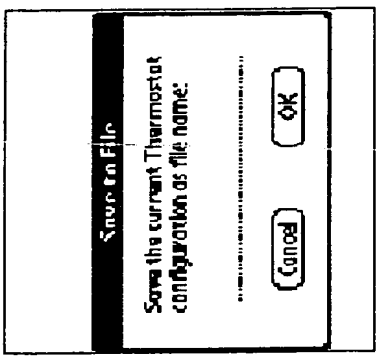

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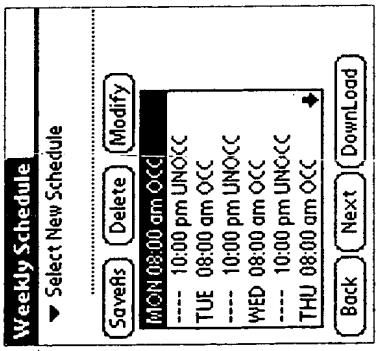

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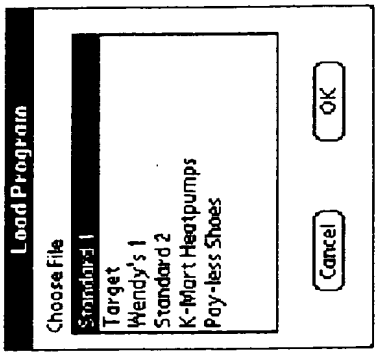

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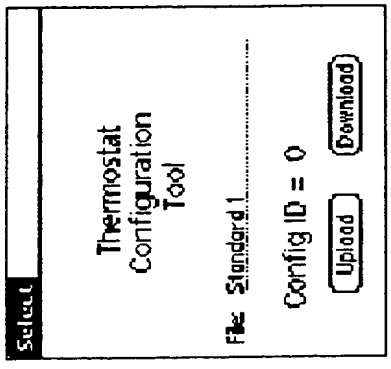

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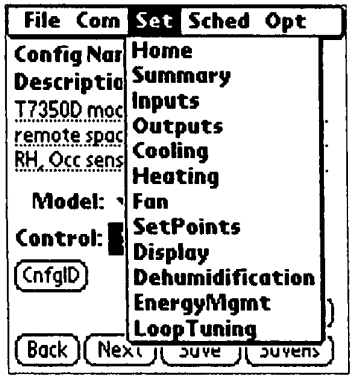

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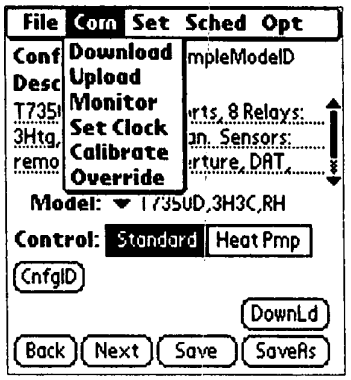

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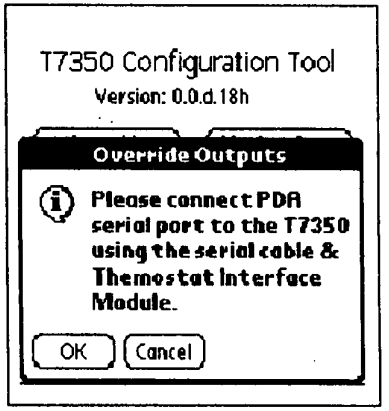

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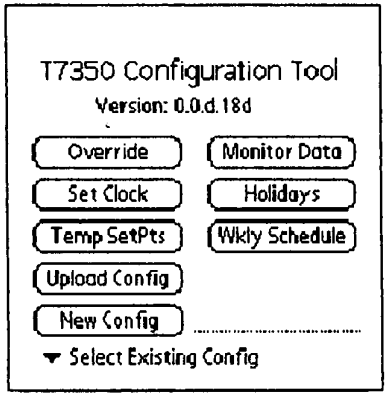

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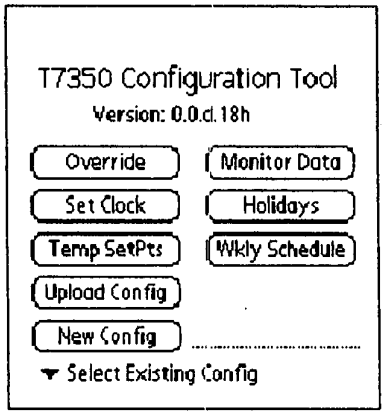

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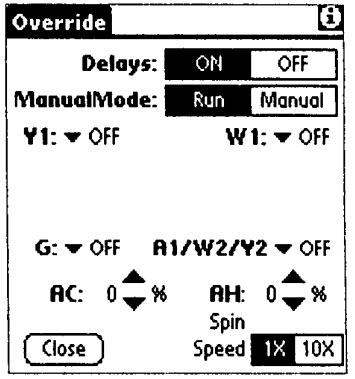

Figure 14V

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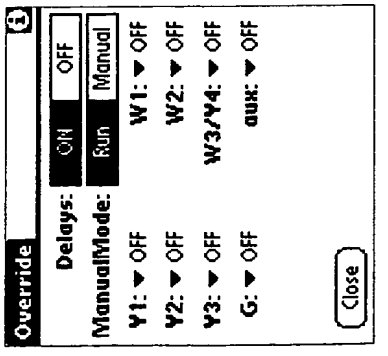
Docket: H0005400(161.1127101)
REPLACEMENT DRAWING



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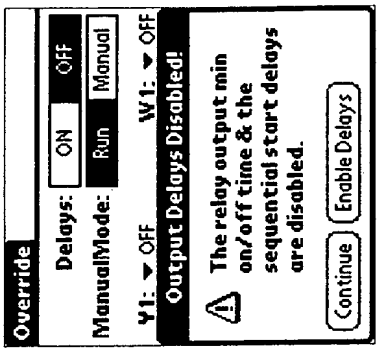

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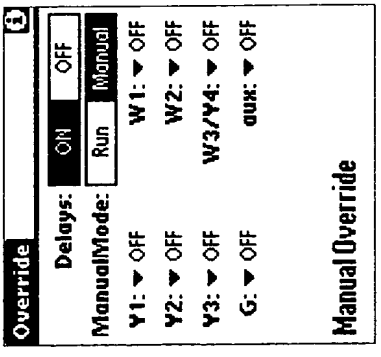

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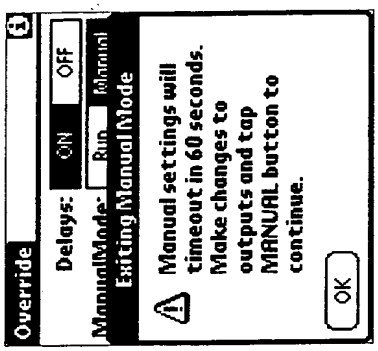

Figure 14Y

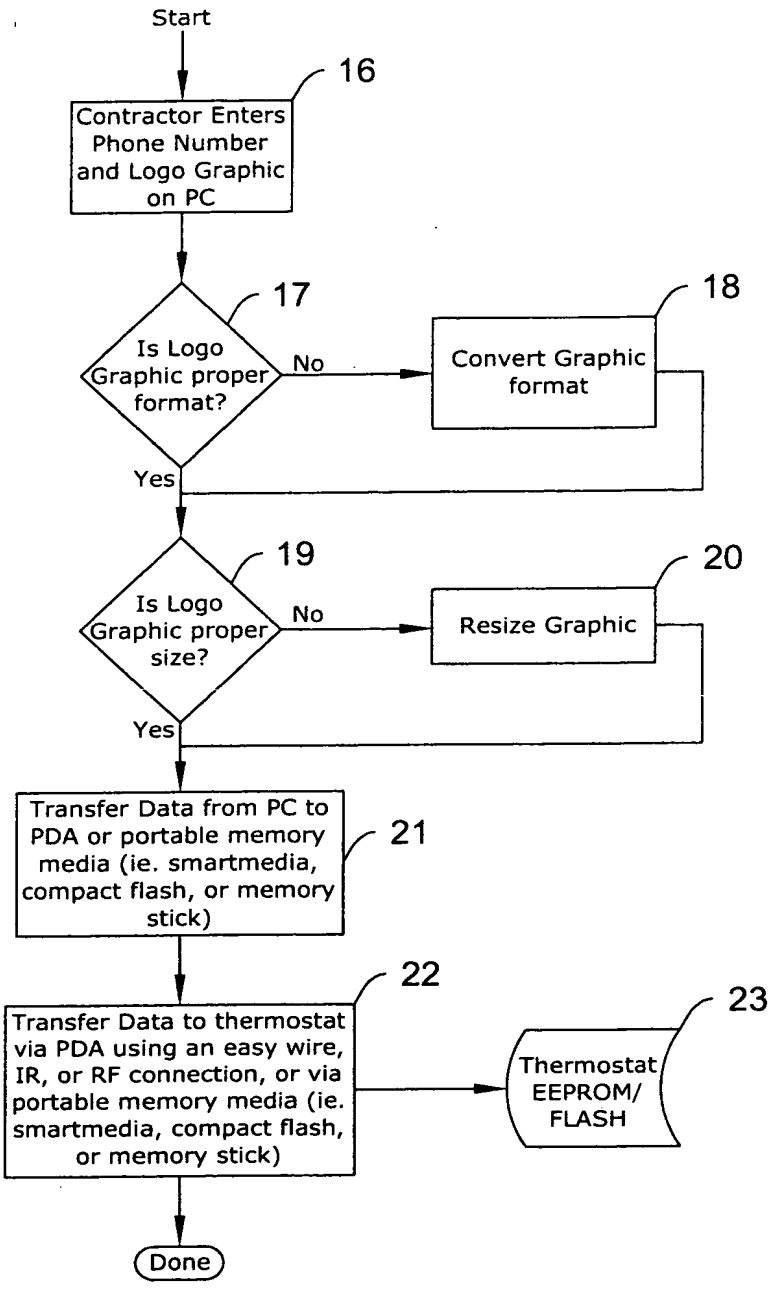
Start
16
Contractor Enters Phone Number and Logo Graphic on PC
17
Is Logo Graphic proper format?
No
18
Convert Graphic format
Yes
19
Is Logo Graphic proper size?
No
20
Resize Graphic
Yes
Transfer Data from PC to PDA or portable memory media (ie. smartmedia, compact flash, or memory stick)
21
22
Transfer Data to thermostat via PDA using an easy wire, IR, or RF connection, or via portable memory media (ie. smartmedia, compact flash, or memory stick)
23
Thermostat EEPROM/ FLASH
Done

Figure 15

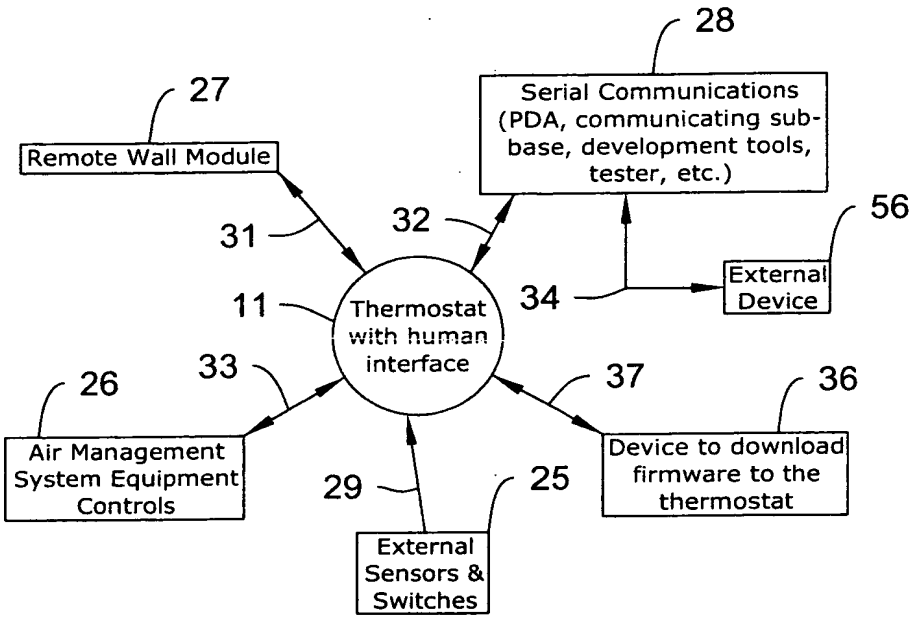
28
27
Serial Communications (PDA, communicating sub-base, development tools, tester, etc.)
Remote Wall Module
31
32
56
External Device
34
11
Thermostat with human interface
33
26
37
36
Air Management System Equipment Controls
Device to download firmware to the thermostat
29
25
External Sensors & Switches

Figure 16

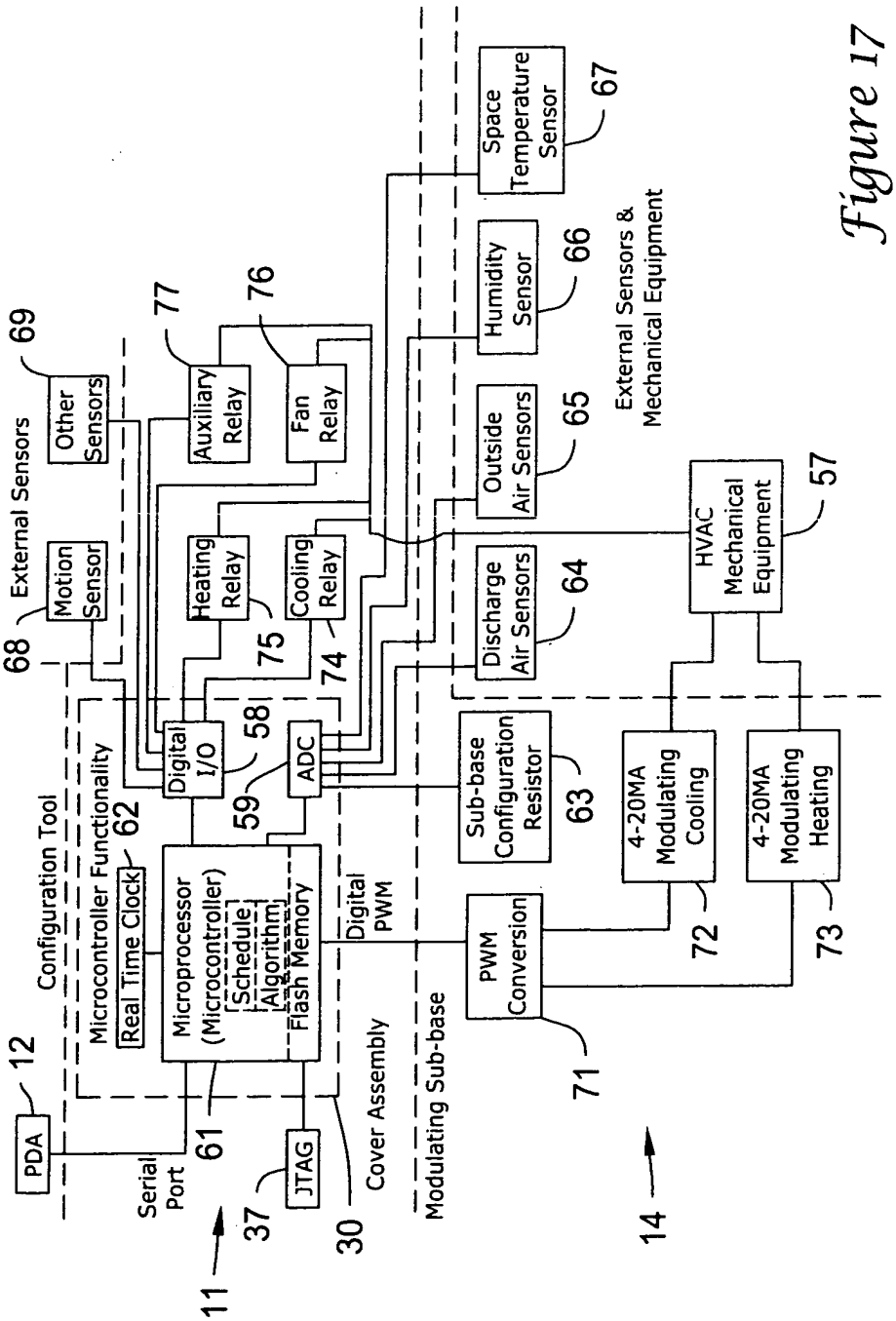
PDA
12
Configuration Tool
Microcontroller Functionality
Real Time Clock
62
Microprocessor (Microcontroller)
Schedule
Algorithm
Flash Memory
Digital I/O
58
ADC
59
Digital PWM
Serial Port
61
JTAG
37
11
Cover Assembly
30
Modulating Sub-base
PWM Conversion
71
Sub-base Configuration Resistor
63
4-20MA Modulating Cooling
72
4-20MA Modulating Heating
73
14
HVAC Mechanical Equipment
57
External Sensors & Mechanical Equipment
Space Temperature Sensor
67
Humidity Sensor
66
Outside Air Sensors
65
Discharge Air Sensors
64
Heating Relay
75
Cooling Relay
74
Auxiliary Relay
77
Fan Relay
76
External Sensors
Other Sensors
69
Motion Sensor
68

Figure 17

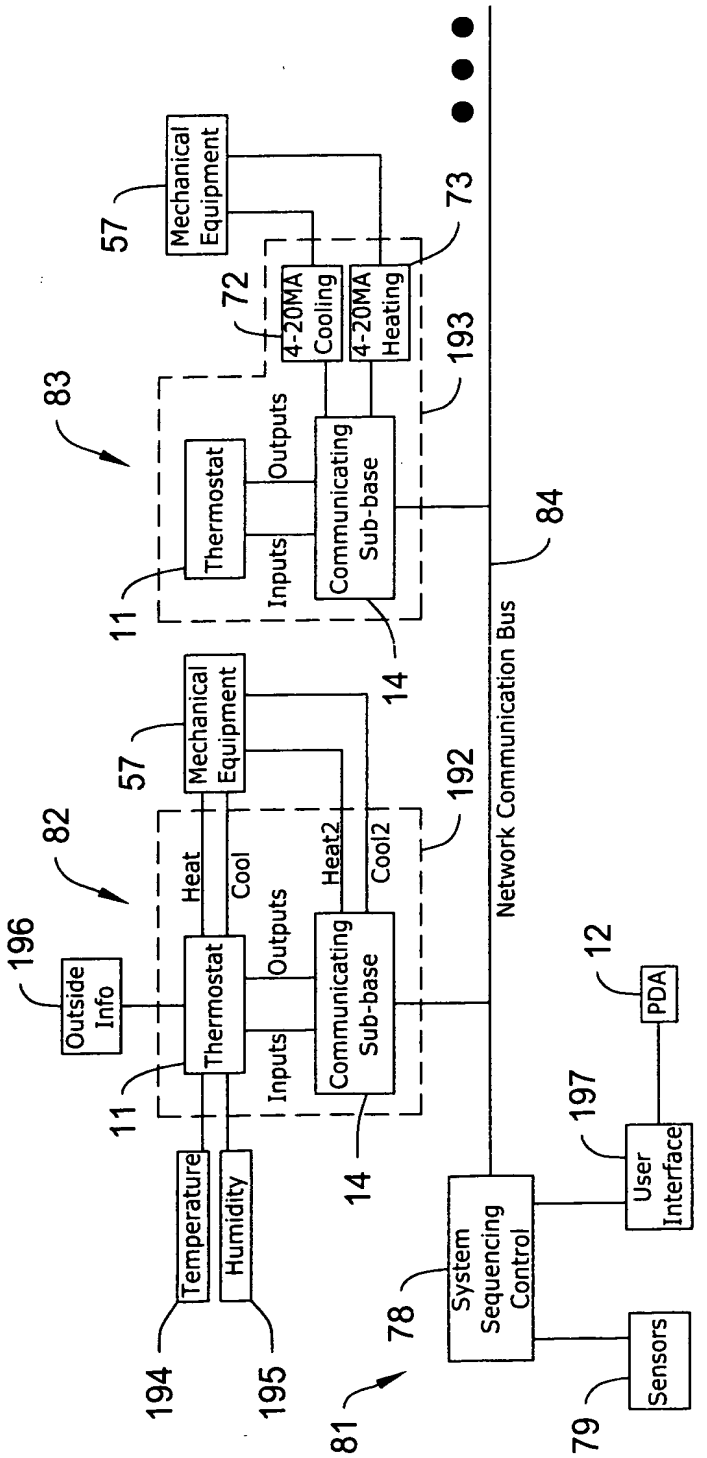
Mechanical Equipment
57
73
72
4-20MA Cooling
4-20MA Heating
193
83
Thermostat
Outputs
Inputs
Communicating Sub-base
11
14
84
Network Communication Bus
Mechanical Equipment
57
192
82
Heat
Cool
Heat2
Cool2
196
Outside Info
Thermostat
Outputs
Inputs
Communicating Sub-base
11
14
12
PDA
197
User Interface
Temperature
Humidity
194
195
78
System Sequencing Control
81
79
Sensors

Figure 18

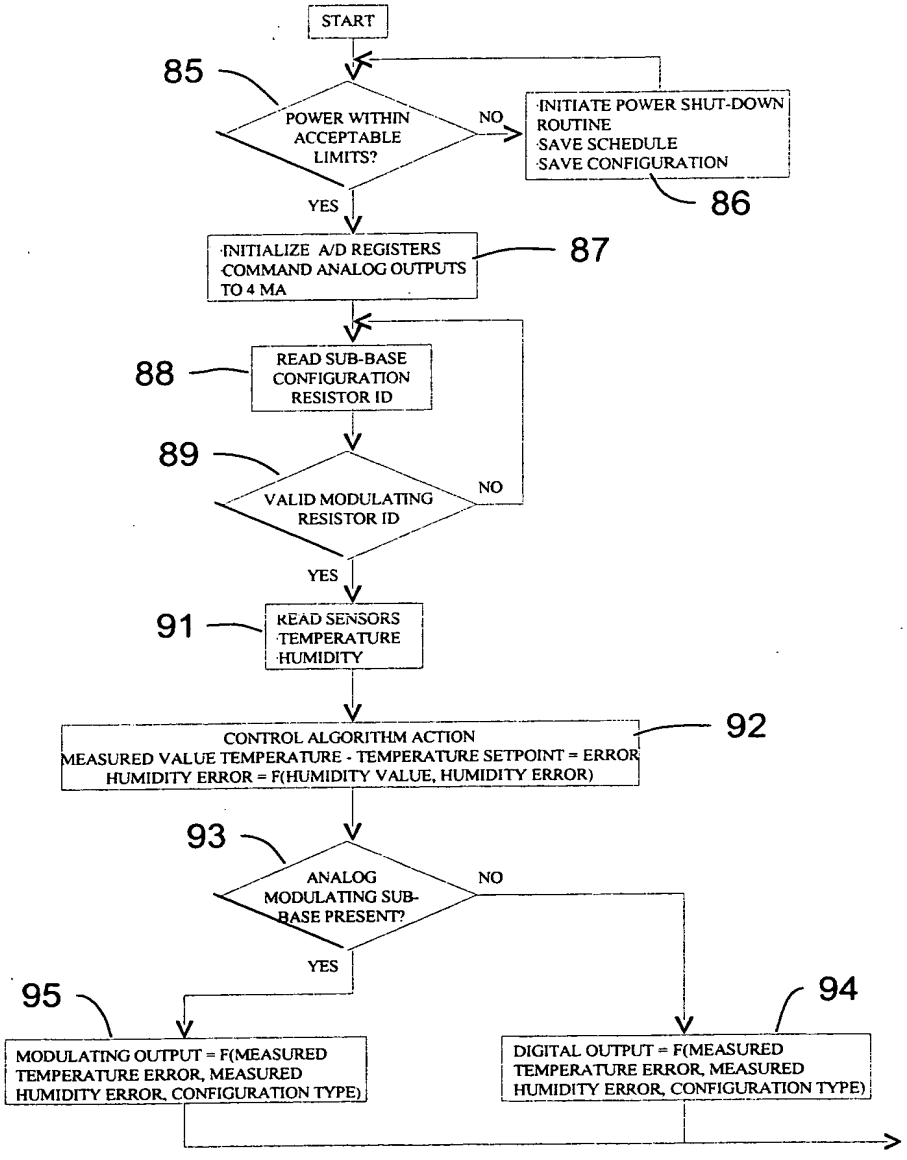
START
85
POWER WITHIN ACCEPTABLE LIMITS?
NO
·INITIATE POWER SHUT-DOWN ROUTINE
·SAVE SCHEDULE
·SAVE CONFIGURATION
86
YES
·INITIALIZE A/D REGISTERS
·COMMAND ANALOG OUTPUTS TO 4 MA
87
88
READ SUB-BASE CONFIGURATION RESISTOR ID
89
VALID MODULATING RESISTOR ID
NO
YES
91
READ SENSORS
·TEMPERATURE
·HUMIDITY
CONTROL ALGORITHM ACTION
MEASURED VALUE TEMPERATURE - TEMPERATURE SETPOINT = ERROR
HUMIDITY ERROR = F(HUMIDITY VALUE, HUMIDITY ERROR)
92
93
ANALOG MODULATING SUB-BASE PRESENT?
NO
YES
95
94
MODULATING OUTPUT = F(MEASURED TEMPERATURE ERROR, MEASURED HUMIDITY ERROR, CONFIGURATION TYPE)
DIGITAL OUTPUT = F(MEASURED TEMPERATURE ERROR, MEASURED HUMIDITY ERROR, CONFIGURATION TYPE)

Figure 19

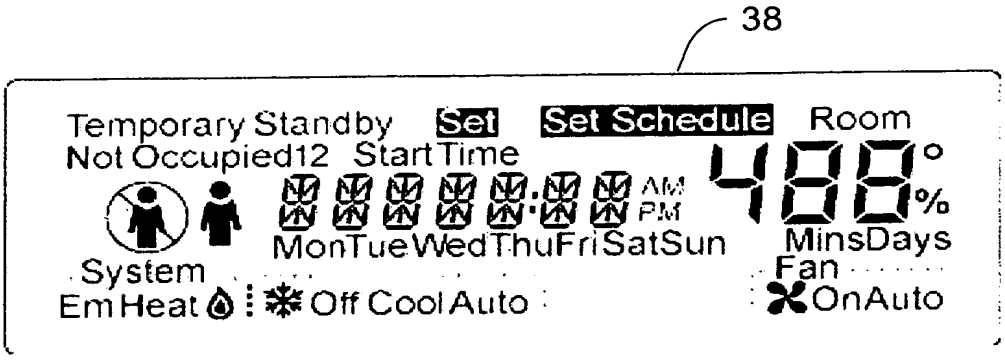

Figure 20A

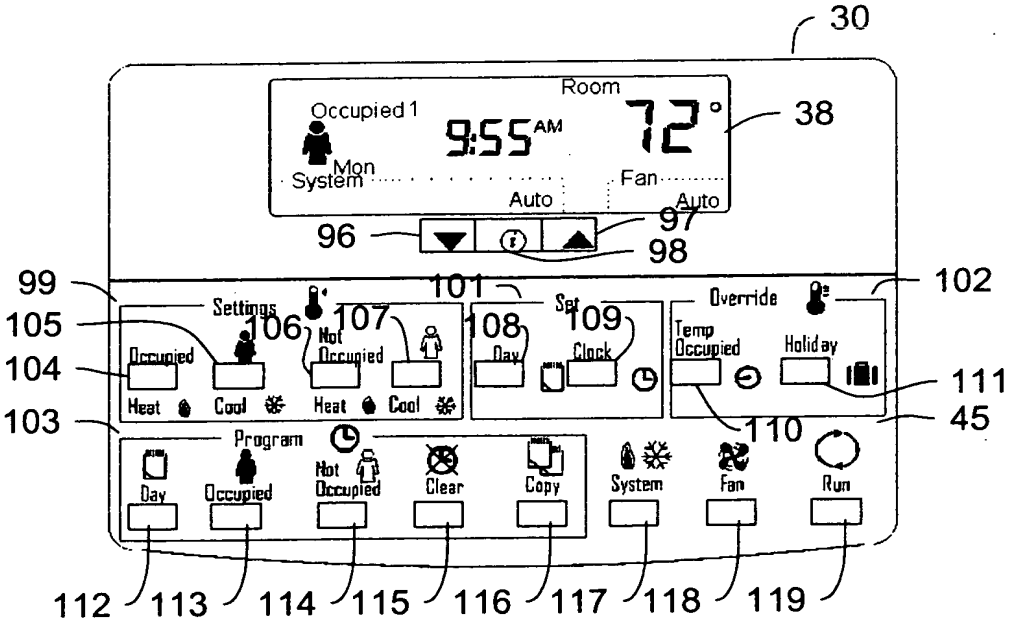

Figure 20B

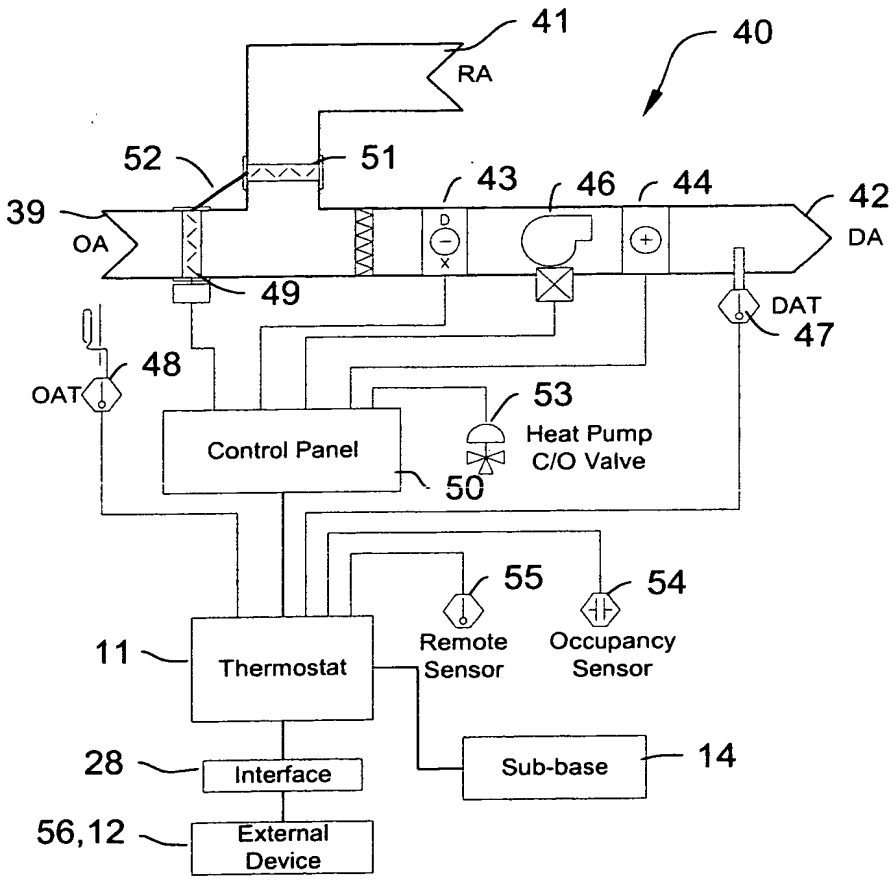
41
40
RA
52
51
43
46
44
42
39
OA
DA
49
DAT
47
48
OAT
53
Heat Pump
C/O Valve
Control Panel
50
55
54
11
Thermostat
Remote
Sensor
Occupancy
Sensor
28
Interface
Sub-base
14
56,12
External
Device

Figure 21

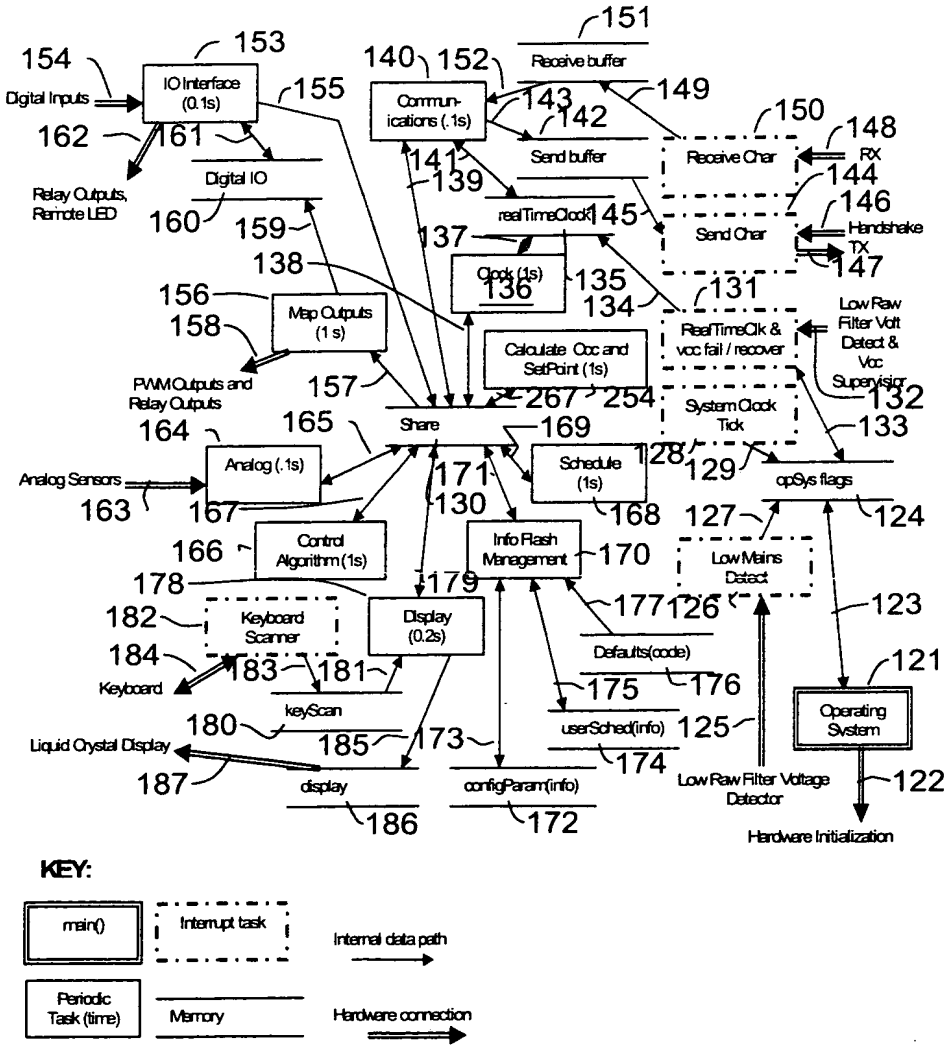
151
Receive buffer
154
153
140
152
149
Digital Inputs
IO Interface (0.1s)
155
Commun-ications (.1s)
143
142
150
148
RX
162
161
Send buffer
Receive Char
141
139
144
Digital IO
146
Relay Outputs, Remote LED
160
159
realTimeClock
145
Send Char
Handshake
137
TX
147
138
Clock (1s)
136
135
156
131
Map Outputs (1 s)
134
Low Raw Filter Volt Detect & Vcc Supervisior
158
RealTimeClk & vcc fail / recover
Calculate Occ and SetPoint (1s)
PWM Outputs and Relay Outputs
157
267
254
System Clock Tick
132
164
165
Share
169
133
Analog (.1s)
Schedule (1s)
128
129
opSys flags
Analog Sensors
171
163
167
130
168
127
124
Control Algorithm (1s)
Info Flash Management
170
166
Low Mains Detect
178
179
177
126
123
182
Keyboard Scanner
Display (0.2s)
Defaults(code)
121
184
183
181
175
176
Keyboard
keyScan
Operating System
180
185
173
userSched(info)
125
Liquid Crystal Display
174
187
display
configParam(info)
Low Raw Filter Voltage Detector
122
186
172
Hardware Initialization
KEY:
main()
Interrupt task
Internal data path
Periodic Task (time)
Memory
Hardware connection

Figure 22

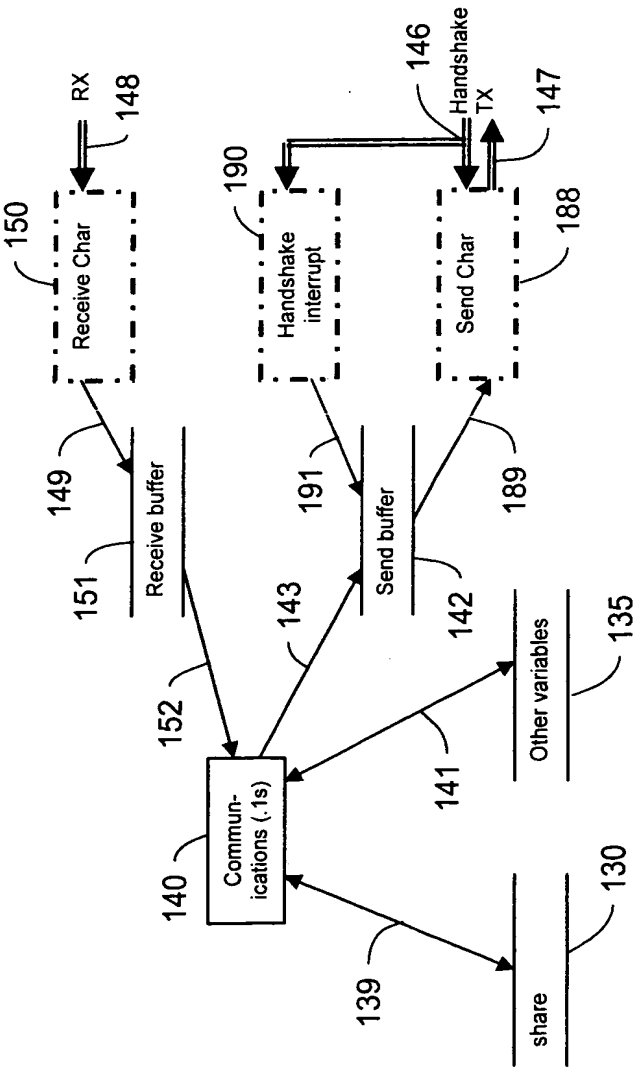
RX
148
146
Handshake
TX
147
150
Receive Char
190
Handshake interrupt
188
Send Char
149
151
Receive buffer
191
Send buffer
189
143
142
152
141
Other variables
135
140
Commun-ications (.1s)
139
share
130

Figure 23

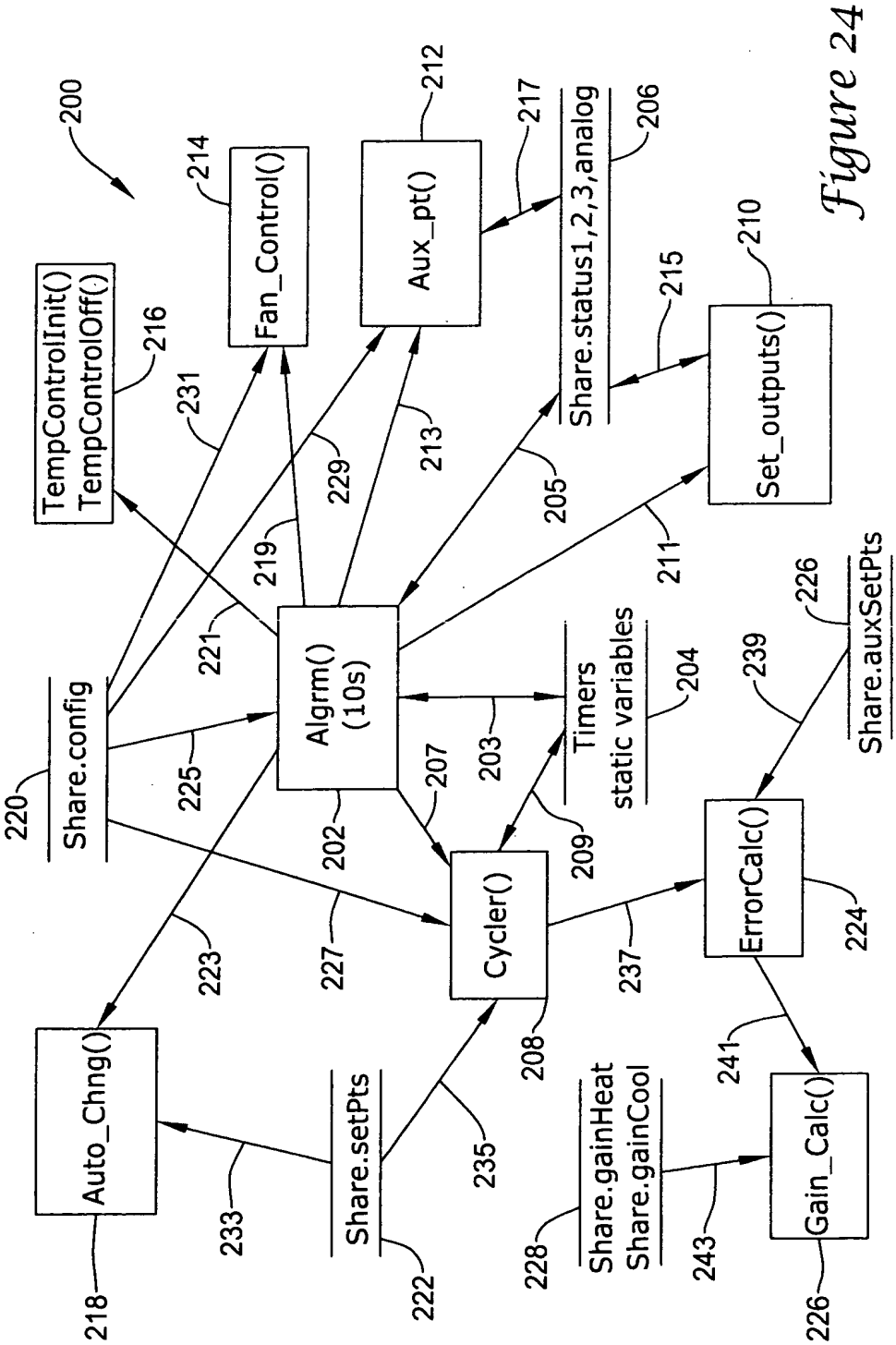
200
TempControlInit()
TempControlOff()
216
Fan_Control()
214
Aux_pt()
212
Share.status1,2,3,analog
217
206
Set_outputs()
210
215
231
229
213
205
219
211
221
Algrm()
(10s)
Timers
static variables
204
203
207
209
202
Share.config
220
225
Cycler()
227
223
ErrorCalc()
239
237
224
Share.auxSetPts
226
Auto_Chng()
218
233
Share.setPts
222
235
208
Share.gainHeat
Share.gainCool
228
241
Gain_Calc()
243
226

Figure 24

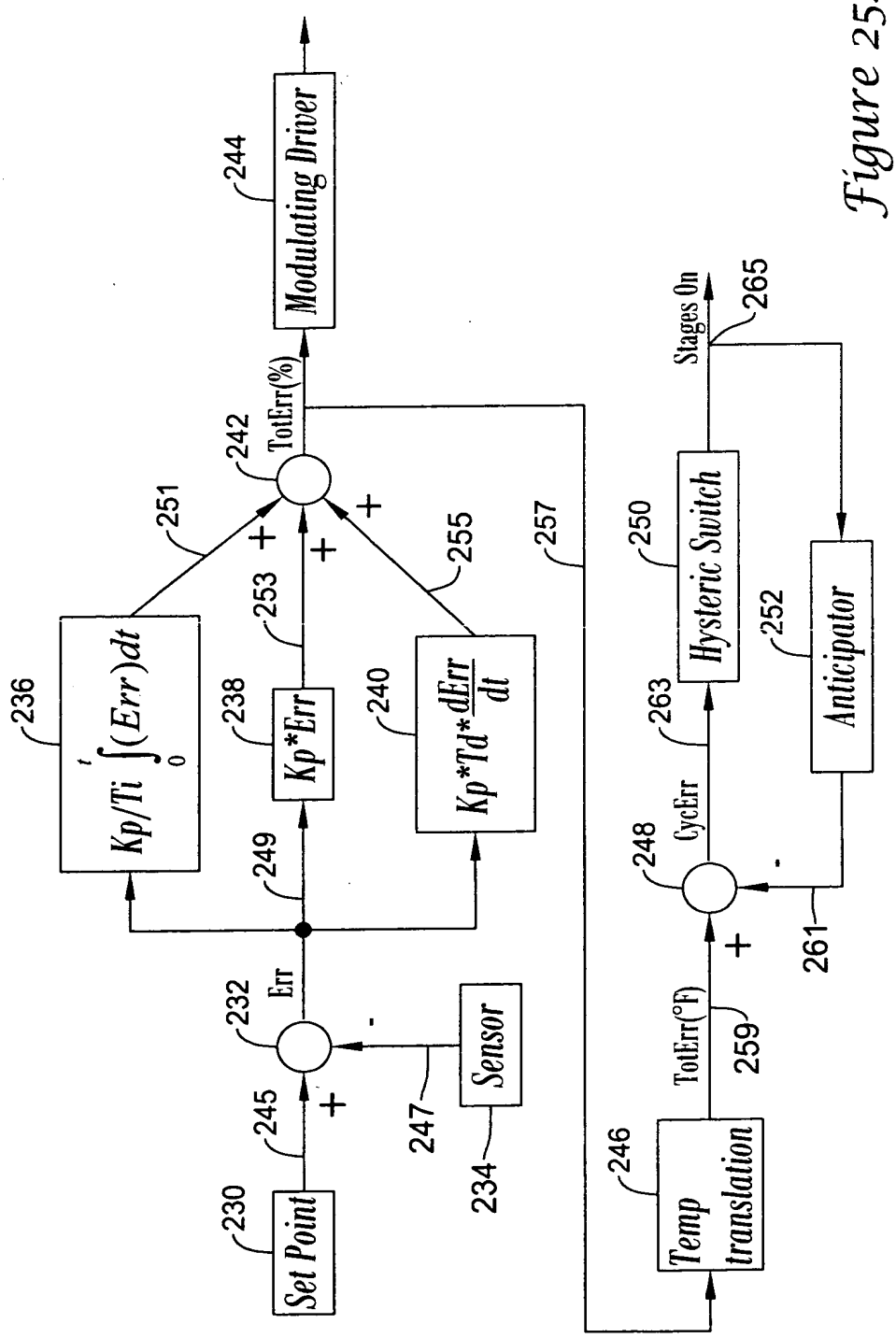
Modulating Driver
244
TotErr(%)
242
Stages On
265
Hysteric Switch
250
Anticipator
252
Kp/Ti $\int_0^t (Err)dt$
236
Kp*Err
238
Kp*Td*$\frac{dErr}{dt}$
240
251
253
255
257
Err
232
CycErr
263
248
261
TotErr(°F)
259
Sensor
234
247
Set Point
230
245
Temp translation
246
+
-

Figure 25A

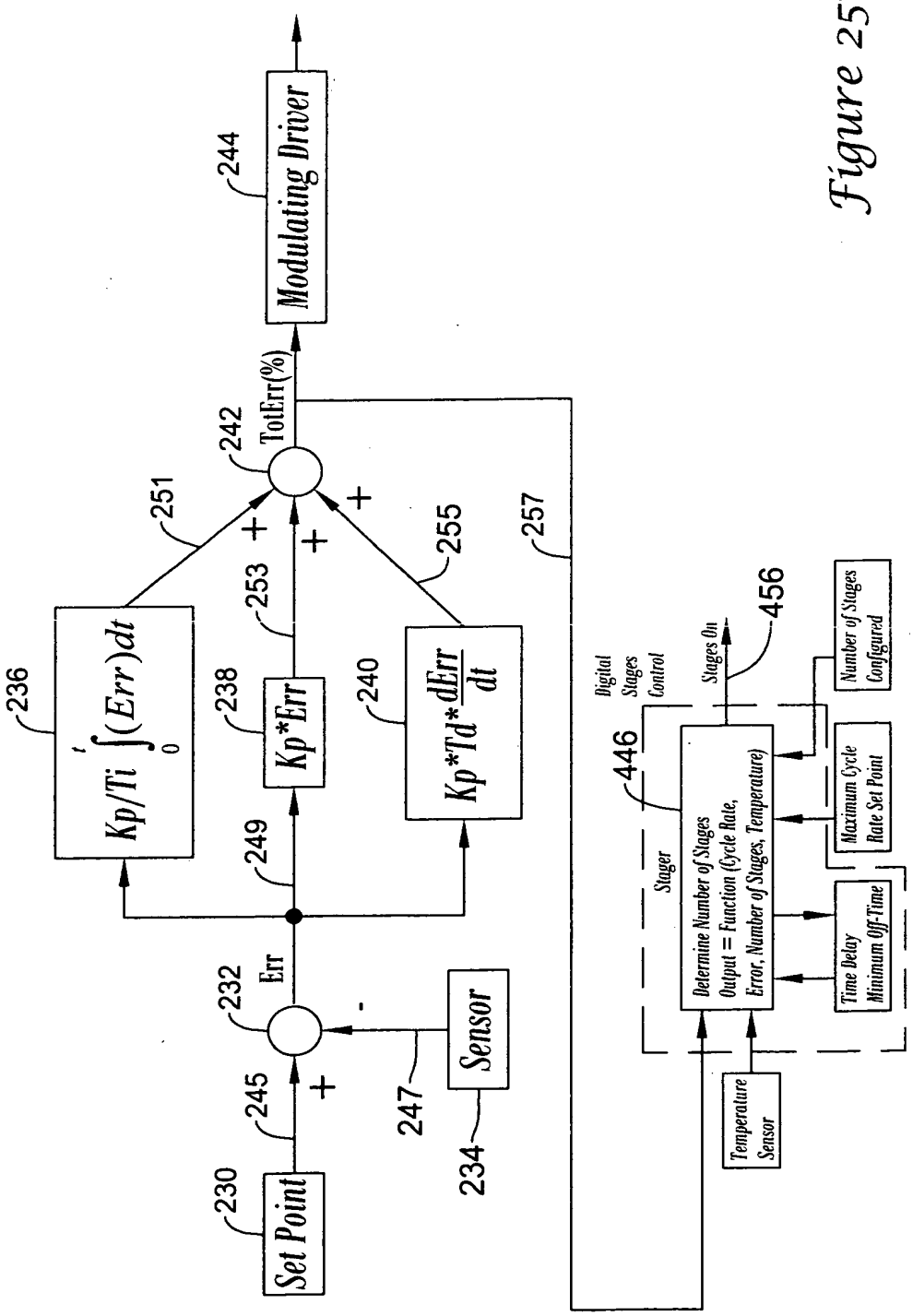
244
Modulating Driver
242
TolErr(%)
251
253
255
257
236
$Kp/Ti \int_0^t (Err)dt$
238
Kp*Err
240
$Kp*Td*\frac{dErr}{dt}$
249
232
Err
245
247
234
230
Set Point
Sensor
+
-
Digital Stages Control
Stages On
456
446
Stager
Determine Number of Stages Output = Function (Cycle Rate, Error, Number of Stages, Temperature)
Number of Stages Configured
Maximum Cycle Rate Set Point
Time Delay Minimum Off-Time
Temperature Sensor

Figure 25B

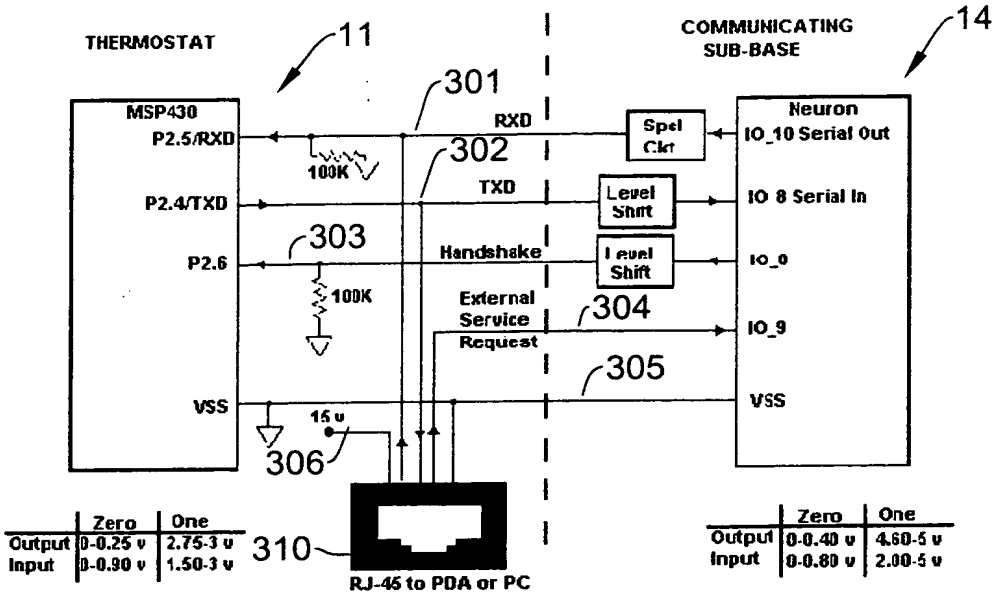

Figure 26

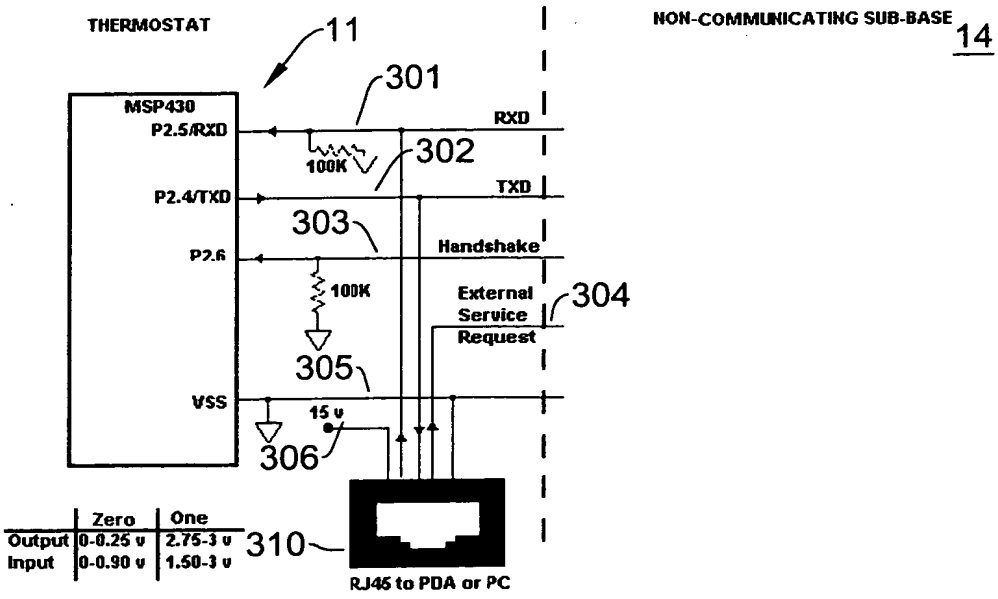

Figure 27

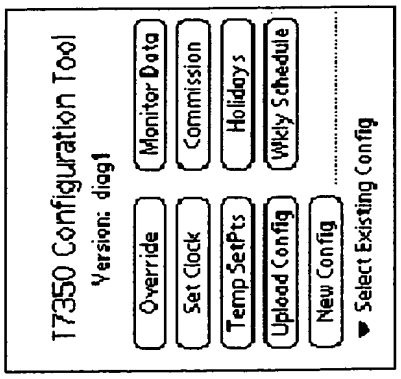

Figure 28A

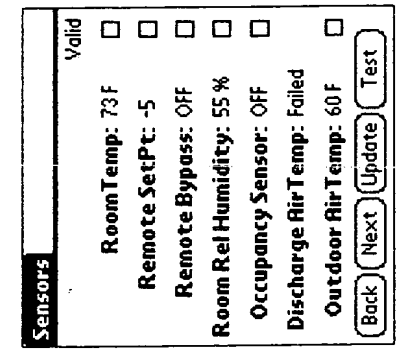

Figure 28C

Figure 29B

Figure 29C

Figure 28B

Figure 29A

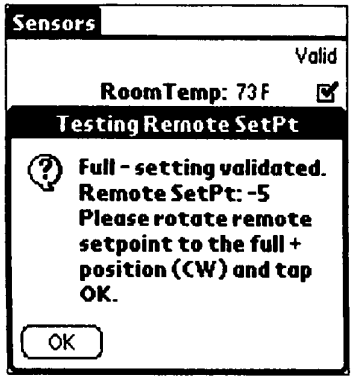

Figure 29D

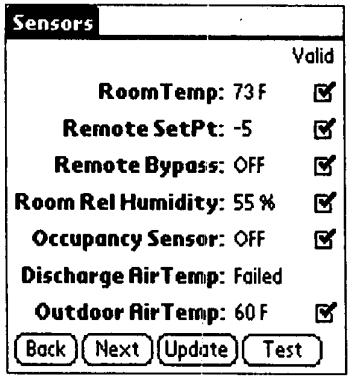

Figure 29F

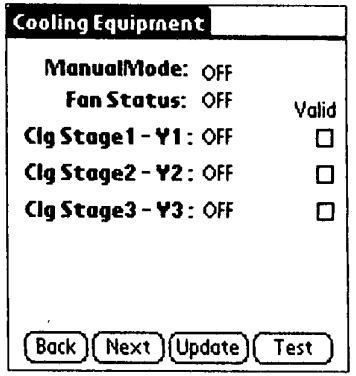

Figure 31A

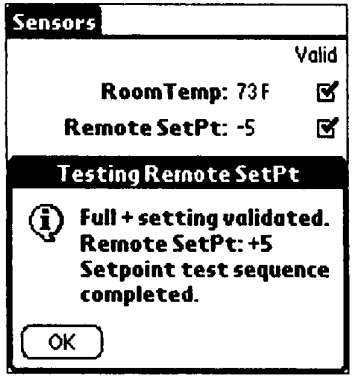

Figure 29E

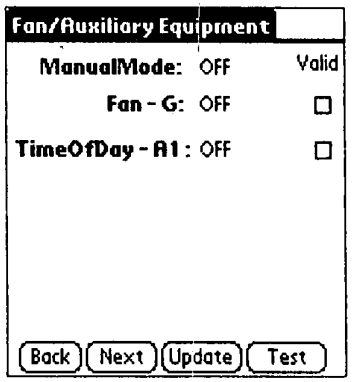

Figure 30

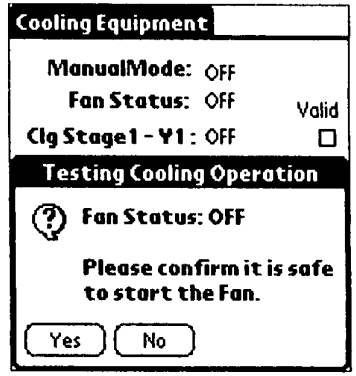

Figure 31B

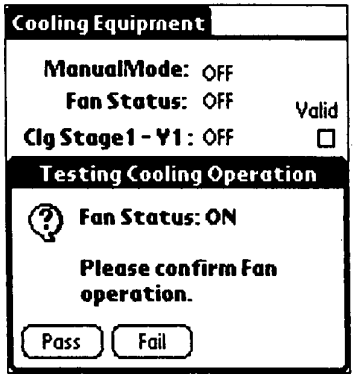

Figure 31C

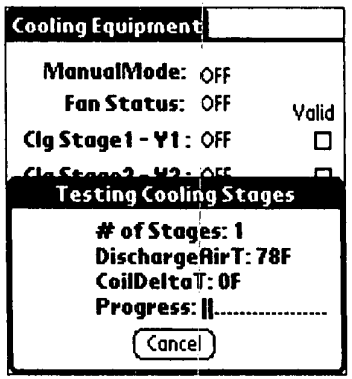

Figure 31E

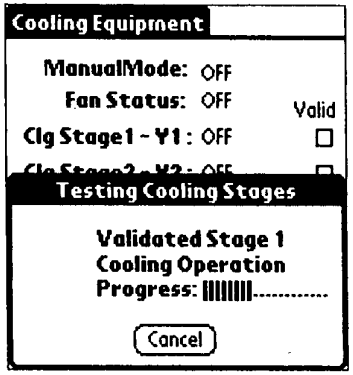

Figure 31G

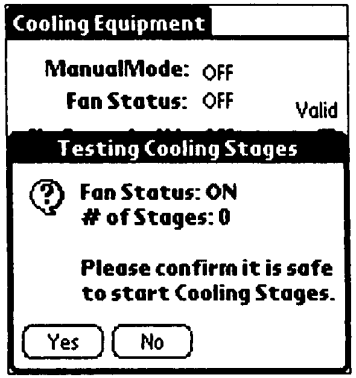

Figure 31D

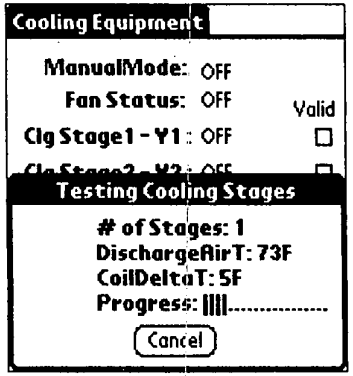

Figure 31F

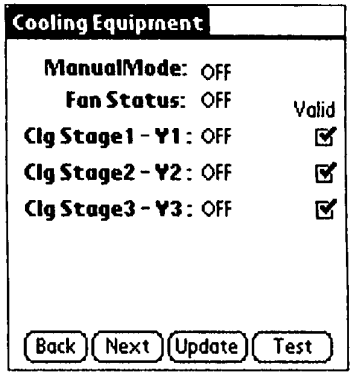

Figure 31H

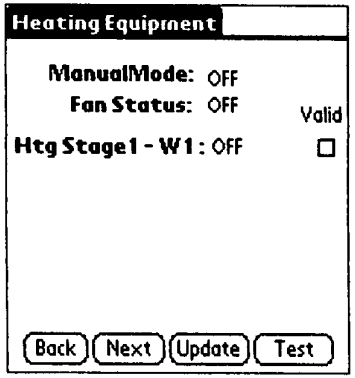

Figure 32A

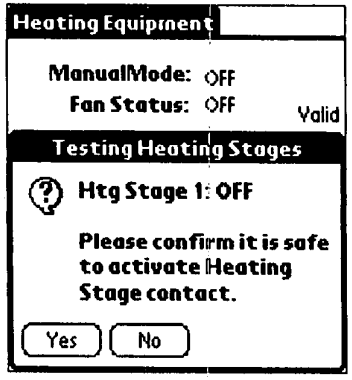

Figure 32C

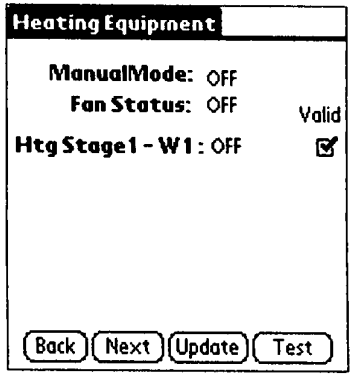

Figure 32E

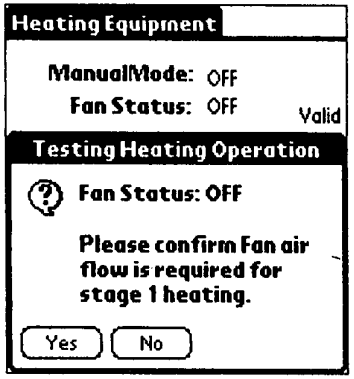

Figure 32B

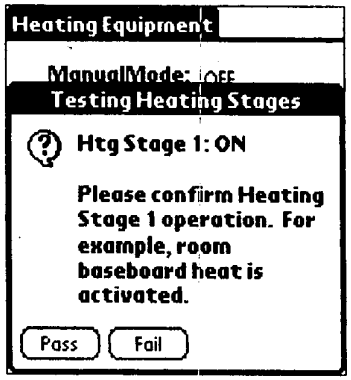

Figure 32D

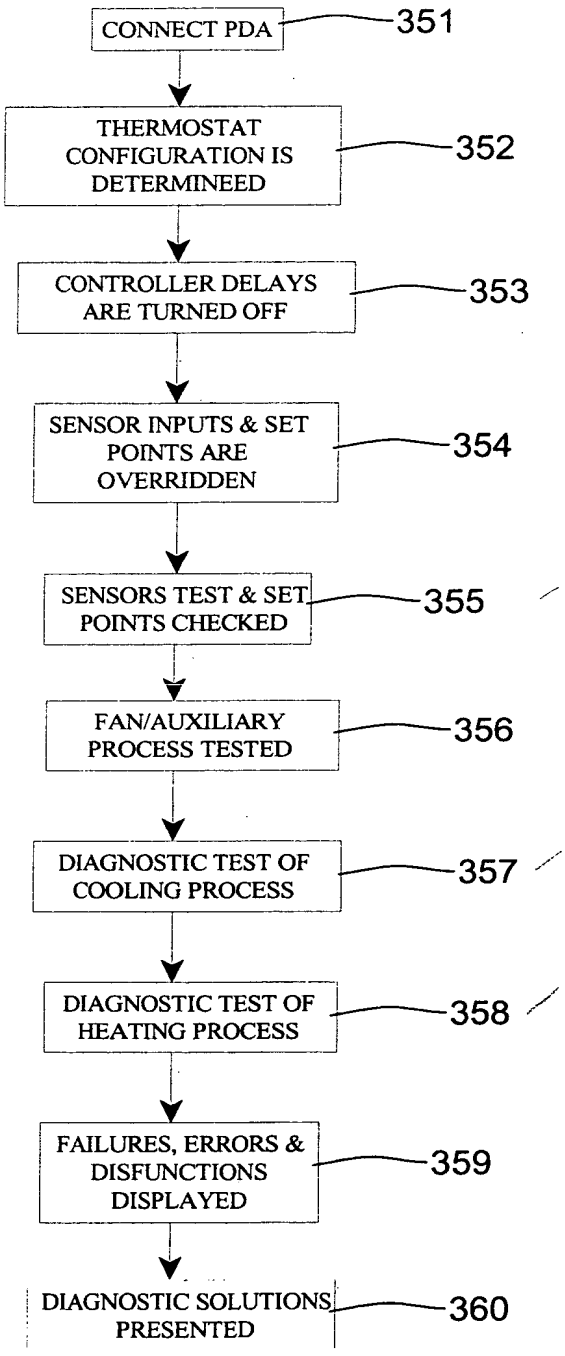
CONNECT PDA
351
THERMOSTAT CONFIGURATION IS DETERMINEED
352
CONTROLLER DELAYS ARE TURNED OFF
353
SENSOR INPUTS & SET POINTS ARE OVERRIDDEN
354
SENSORS TEST & SET POINTS CHECKED
355
FAN/AUXILIARY PROCESS TESTED
356
DIAGNOSTIC TEST OF COOLING PROCESS
357
DIAGNOSTIC TEST OF HEATING PROCESS
358
FAILURES, ERRORS & DISFUNCTIONS DISPLAYED
359
DIAGNOSTIC SOLUTIONS PRESENTED
360

Figure 33